DOCUMENT RESUME

ED 231 178 EC 152 675

TITLE	Communication Aids in Special Education.
INSTITUTION	Education Turnkey Systems, Inc., Falls Church, Va.
SPONS AGENCY	Special Education Programs (ED/OSERS), Washington, DC.
PUB DATE	Apr 83
CONTRACT	300-81-0377
NOTE	21p.; For related documents, see EC 152 672-674.
PUB TYPE	Information Analyses (070)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Blindness; *Communication Aids (for Disabled); Computer Programs; *Educational Technology; Electromechanical Technology; *Hearing Impairments; Partial Vision; *Physical Disabilities; *Special Education; Television; *Visual Impairments

ABSTRACT

One of four reports designed to assess the current state of new technologies, the document reviews the current status of technologically oriented communication aids for the handicapped. Explained are such technological aspects as the characteristics of electronically based devices which permit special students to have access to technological applications in education. Emphasized is reluctance of private firms to develop aids due to the "thin" market, and noted are roles of individuals and organization in developing aids with federal funds. Described to aid communication of four exceptionalities are the following devices (examples are in parentheses): (1) partially sighted (high powered lenses, television cameras and systems), (2) blind (readers, recording, Braille system), (3) hearing impaired (speech interpretation, voice recognition components), and (4) nonvocal physically handicapped (special menus on the computer display, voice recognition/microcomputer systems). Six organizations which make communication devices are listed. Among factors described as affecting use of communication aids are need for information about availability, need for staff training in local schools, and imaginative funding. The summary both synthesizes information presented and makes such forecasts as that there will be a wider range of communication aids available in the next five years. (MC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED231178

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☑ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

COMMUNICATION AIDS IN SPECIAL EDUCATION

APRIL 1983

EDUCATIONTURNKEYSYSTEMS inc

256 NORTH WASHINGTON STREET
FALLS CHURCH, VIRGINIA 22046

EC152615

This report was produced by Education TURNKEY Systems, Inc. under Contract Number 300-81-0377, "Assisting LEAs to Adopt New Technologies", from Special Education Programs, U. S. Department of Education. The opinions expressed in this document are those of TURNKEY and do not necessarily reflect the policy or views of the U.S. Department of Education.

Preface

This document is one of four reports designed to assess the current state of new technologies, review the current uses of the technologies in regular and special education, and project the manner in which these technologies will affect special education during the next five years. These reports address four very important categories of new technology: microcomputers, telecommunications, videodiscs, and communication aids.

The information presented in this report is the result of the distillation of a great deal of data from a wide variety of information sources. Foremost among these sources were:

- discussions with high-level officials from more than 60 firms which develop, produce, publish, or distribute technology hardware and software;
- responses of nearly 200 high-level LEA special education officials who attended four project technology workshops;
- information reported by such education and industry organizations as TALMIS, Knowledge Industry Publications, the National Audio Visual Association (Materials Council), the National Association of State Directors of Special Education, the TRACE Center, and the Society for Applied Learning Technology;
- Federal reports sponsored by the National Science Foundation, the National Center for Education Statistics, the Office of Technology Assessment, ED/Division of Education Technology, and ED/Special Education Programs (SEP); and
- independent research studies and surveys.

In addition to these project sources, Education TURNKEY Systems staff has conducted workshops on technology applications in special education for more than 4,500 state and local special education administrators.

The trends, estimates, and projections contained in this report have been derived from many sources and represent the best estimates of Education TURNKEY Systems and The Futures Group.

TABLE OF CONTENTS

I. THE TECHNOLOGY 1

II. GENERAL EDUCATION USE 2

A. Visually Impaired 4

1. Partially Sighted 5
2. Totally Blind 5

B. Hearing Impaired 9

C. Nonverbal Physically Handicapped 10

IV. FACTORS AFFECTING USE 13

A. Information 13

B. Training 13

C. Funding 14

D. Federal Involvement 14

E. External Influence 15

V. SUMMARY 15

COMMUNICATION AIDS IN SPECIAL EDUCATION

Modern electronic technology has created devices which greatly enhance the ability of certain types of handicapped individuals to communicate in their home, work, and education environments. This document presents a description of many such technology advances and their roles in special education -- now and in the near future.

I. THE TECHNOLOGY

Communication aids are not, in truth, a separate technology. Rather, they are a series of specialized applications of many technologies, most of which are electronics-based. Conceptually, these communication aids are new technology devices which permit special education students to provide input to, or receive output from, either traditional education or other new technology applications in education. More specifically, these are most often self-contained adaptive devices (e.g., reading machines) or input/output devices (e.g., voice synthesis) for other technological components (e.g., microcomputers). It is also noteworthy that these communication aids rarely have a separate software component; because of the specialized purpose of the devices, appropriate software is usually integrated into the hardware.

It has been said that all adaptive devices for the handicapped are intended to improve either the mobility or communications ability of disabled individuals. This discussion does not include devices (e.g., electronically controlled wheelchairs) whose primary function is directed at improved mobility. Important as such aids may be to the individual, they are only peripheral to the education process. It is the inability to communicate effectively that puts the handicapped individual at a disadvantage in the educational environment. It is devices directed at improving communication ability which is the intended focus of this discussion. These aids represent a diverse range of mechanisms covering a wide spectrum of handicapping conditions for which the communication aids are appropriate.

The range and number of such aids is so large that mention of all must be precluded. This report, however, provides descriptions and examples of communication aids which offer particularly high potential for improving special education and access to it.

It should be further noted that, while the term special education encompasses students with a broad array of handicapping conditions, it is only those with special communication problems that are of concern in this scenario. Specifically, we will explore communication aids for the sight impaired, the hearing impaired, the nonvocal, and the physically disabled.

II. GENERAL EDUCATION USE

For nonhandicapped students, the basic senses of sight, hearing, and touch allow most students to have access to virtually all educational opportunities -- whether technology-based or not. In special education, however, sensory-deprived and motor-deprived children often cannot avail themselves of certain learning resources. Indeed, it is a paradox that technology has greatly increased the complexity of modern living, thus further encumbering handicapped persons, while at the same time offering the opportunity for new applications of technology which can provide the handicapped with greater access to information resources.

The communication aids discussed here are, in general, outgrowths of devices or techniques developed as environmental aids (i.e., aids to enhance everyday living) for handicapped individuals. Their educational applications are frequently, however, direct adaptations of their more general uses.

Almost by definition, these devices must be designed to serve those with a specific handicap; indeed, many are custom designed to the needs of a specific handicapped individual. This narrow range of users means that, from the standpoint of developers, the market is too "thin" to justify major developmental efforts -- that is, the potential market for these aids is severely limited by the small number of individuals with specific handicapping

conditions. Such small markets reduce incentive for costly development while, at the same time, they make impractical mass production of the technology which is available.

As a consequence of this thinness in the market, little of the developmental effort is conducted by private firms. Rather, the bulk of the devices falling into this communication aids category have been originally developed by:

- private individuals responding to the specific needs of a handicapped person;
- nonprofit organizations and consumer groups serving the handicapped;
- universities or research organizations operating with government or foundation research and development funding; or
- government facilities which develop/adapt aids for distribution.

Most high technology developments in communication aids are presently in an experimental or prototype form. Only in rare circumstances are such devices, with their inherently limited markets, picked up by manufacturers for major development and production. The products which are produced and marketed by private firms are those which can easily be adapted/interfaced with lower cost commercially available technology (e.g., microcomputers, videodiscs).

It is, in part, for this reason that the costs of these specialized communication aids have not decreased in the same manner as other new electronics technologies. As technological breakthroughs reduce the costs of manufacturing microcomputers, for example, and as their market has broadened, the cost to the consumer for such products has dropped dramatically. Because the market for the communication aids discussed here will remain relatively narrow, their costs have not and should not be expected to decrease in the same manner as have microcomputer costs.

The technological devices to be discussed here are, by their very definition, mechanisms to allow handicapped individuals to communicate

effectively with the education system. Although such devices have utility in regular education, the fact that they are designed for handicapped individuals indicates that their most direct instructional value will be in special education.

III. SPECIAL EDUCATION USE

There have been a wide range of devices developed to help handicapped individuals function and communicate in their day-to-day affairs. For purposes of this study, however, we are not interested in those devices whose major purpose is to provide general assistance to the handicapped. Rather, we will concentrate our attention on those communication aids which offer now, or have the potential to offer in the near future, direct benefit in the special education milieu.

In this discussion are described the various technologies grouped by the nature of the handicap they are designed to address:

- visually impaired;
- hearing impaired; and
- nonvocal/physically disabled.

Students with these handicaps are those who most often need communication assistance.

A. VISUALLY IMPAIRED

In education, sight is one of the primary means of student information gathering. Even when the teaching mode is primarily verbal (e.g., an instructor's lecture), the recreation of that verbal activity for later study could be a problem for blind students. The advent of portable tape recorders was a boon to visually disabled students, allowing them to tape record classroom activity for use at a later time, in much the same manner a sighted student might use class notes.

1. Partially Sighted

For those individuals with low vision, modern electronics and micrographic (e.g., microfilm, microfiche) technologies make possible much greater flexibility in large print reading materials. High powered lenses (up to 50 times normal size) and television cameras and monitors can form reading and writing systems for persons with partial sight. Closed circuit systems may be configured to include capabilities for viewing material in a typewriter or to display information from a microfiche reader or a computer screen. Among the firms which manufacture such systems are Visualtek, Apollo Laser, and Pelco Sales.

2. Totally Blind

Totally blind persons are clearly more isolated from their education environment. There have been three ways by which blind individuals have had access to printed material: readers, recordings, and Braille. The first offers the widest range of materials but suffers obvious drawbacks in time flexibility and cost. The other two systems may allow for more convenient use, but are clearly limited in terms of the amount and nature of available materials. New technological advances have greatly enhanced the advantages of each of these three means of providing blind persons with access to information systems.

a. Readers

While a human reader as an aide is still (and certainly will remain) the most accurate and flexible means of access to printed and electronic materials for the blind, a number of electronic devices have been developed which allow the printed word to be translated into a form "readable" by the blind. What they share is the recently refined capability of "optical character recognition" (OCR).

A service called a "direct translation reading aid" is the Optacon (OPtical-to-TActile CONverter), manufactured by Telesensory Systems, Inc. The Optacon system includes a hand-held camera, about the size of a pack of chewing gum, which scans a line of print and, using a matrix of photo transistors, converts the letter images to Braille-like tactile signals through a series of tiny vibrating pins in the receiver unit. The Optacon is battery-powered and quite portable, making it extremely important in reducing the mobility barriers faced by blind persons in schools or elsewhere. Devices such as the Optacon may be extremely valuable in special education, permitting blind students to have access to a much wider range of printed materials. It has been estimated that more than 8,000 Optacon systems are now in use worldwide. The major disadvantages of the Optacon are its lack of speed (about 40 words per minute after a year of practice) and the complex finger-tip sensitivity and coordination necessary to scan and "read" images.

An extremely useful union of the optical character recognition (OCR) and speech synthesis technologies is the Kurzweil Reading Machine, manufactured by Kurzweil Computer Products, now an affiliate of the Xerox Corporation. This device, originally supported by Federal funds, converts printed or typed material into full-word synthetic speech. Printed matter, in any of a variety of type sizes or styles, is placed on a scanner which looks and operates much like a small copying machine. An electronic camera sends electronic image signals to a microprocessor which forms the image into discrete character strings (words) and produces a "natural" sounding, contoured synthetic speech. In addition to its obvious value to blind persons in general and special education students in particular, the device, using its speech output component, can, when connected to a personal computer, become a "talking" output terminal. This would enable blind students to have much the same access as sighted persons to such computer applications as word processing and electronic mail. The OCR component may be connected to a personal computer as an input device for blind persons. The Kurzweil Reading Machine has also proved useful for dyslexic (reading impaired) individuals. There are an estimated 300 such machines in use today; since most are in institutions (e.g., schools, libraries), their use is shared by about 3,000 users.

Since many visually impaired persons have the ablity to touch type, they are generally able to input data into computers through their keyboards. The availability of synthetic speech has provided great value for computer output. A number of "voice synthesizer" or "talking terminal" applications have been developed to aid the blind as they interact with electronic technology. Among these are:

- The Orator, produced by ARTS Computer Products, Inc., a microcomputer application which can either speak whole words or spell each character.
- The Magic Wand, produced by Texas Instruments, an optical scanner wand which translates bar codes in special instructional materials into synthetic speech.
- Total Talk, a "talking terminal", developed by Maryland Computer Services, Inc.
- "Voice modules", synthetic speech components becoming available on many makes of microcomputers and video games.

b. Recordings

Since the 1930s, sound recordings have served as a means of giving the blind access to printed materials. The technologies associated with sound recording have changed over the years and, with the advent of cassette tape recordings, now provide an extremely convenient device for using such recordings.

Variable speed controls on tape recorders have enabled blind users to "speed listen" at rates much greater than normal. The increase in pitch ("the chipmunk effect") resulting from high-speed playback has, in recent years, been ameliorated by special electronic circuits which allow undistorted playback at speeds up to two and one-half times normal.

The two major drawbacks of recordings for the blind are that: (1) there is a limited selection of prerecorded documents; and (2) existing recordings must be accessed sequentially rather than randomly as a sighted reader might access them (as, for example, scanning chapter headings until the desired

section is found). This latter disadvantage may be overcome through the use of a personal computer by electronically annotating a recording and rerecording the annotated version onto floppy disks. A blind student could then hear a vocalization of a table of contents, providing him or her with random access to any part of the recording.

c. Braille

Braille, as a system which permits blind and deaf-blind persons to communicate, was developed during the nineteenth century and has been in use ever since. Braille is cumbersome, not correctable, and requires the user to master a difficult skill. It is, nevertheless, an extremely valuable communication tool for the blind; this value may be enhanced by modern technology.

Modern Braille machines can code Braille images on magnetic tape in digital form, allowing for as many as 600 pages of paper Braille to be stored on a single tape cassette. Some microprocessor-controlled Braille systems, such as VersaBraille (produced by Telesensory Systems, Inc.) allow for correction capability, word or character search, and easy location of desired tape locations.

Similarly, Braille printing terminals have been developed for computers which allow any output to be printed in Braille as well as in standard type. Such systems allow students to tape record class instruction (e.g., lectures), transcribe the tape by touch typing it into a microcomputer file, and print out a Braille transcription of the activity. While Grade I Braille (letter-by-letter) may be incorporated into a printer fairly readily through change in type font and addition of Braille-sensitive paper, a number of new software and printer systems have recently been developed which can produce Grade II Braille (letters and word contractions). The Duxbury Braille Translator, manufactured by Duxbury Systems, Inc., can produce Grade II Braille at rates of more than 1,000 words per minute with a minicomputer; it may also be used with microcomputers, although at a lower output rate. Similarly, the Braillemboss, produced by the Massachusetts Institute of Technology, is a Braille teletype computer output device which produces Grade II Braille.

Currently available are a number of "paperless Braille" terminals which function much as a CRT does for a sighted user, providing immediate but not savable output. Paperless Braille systems, some of which are supported by SEP funds, usually use a platen with a series of six or eight pins which are raised electromechanically to form the raised dots of the Braille characters. Such paperless Braille devices often allow for as many as 40 characters to be displayed at a time. The Digicassette, a product of Treformation Systems, Inc., is a paperless Braille device which has the capacity to store, on standard tape cassettes, desired Braille images. It can also be used as a Braille adjunct to electronic calculators, electric typewriters, and microcomputers.

B. HEARING IMPAIRED

The handicaps faced by hearing impaired students fall into two basic areas: the inability to hear verbal classroom information and the inability to hear one's own speech, making difficult the development of proper verbal language skills. Although these are different handicaps, the technological aids used to address them are generally quite similar.

It should be noted that, technologically, communication aids for the hearing impaired may often be looked upon as the inverse of aids for the visually impaired. The technology embodied in the Kurzweil Reading Machine for the blind, for example, has the capability of translating typed or printed material into understandable spoken text. The reverse conversion -- translating spoken words into a print medium -- is the ideal means by which technology can help the deaf to hear. Unfortunately, this technology does not yet exist. While the deciphering of written symbols (optical character recognition) has a finite number of print styles with which to deal, the translating of the spoken word requires recognition of a virtually infinite number of accents and dialects.

A number of developmental efforts have been undertaken toward speech interpretation for the hearing impaired. In England, Newell has developed a device which can provide a phonetic transcription of the spoken word. Efforts have taken place at the Boston Public Television Center, with Federal support, to develop an automated captioning system for television. Other researchers have developed communication aids which convert speech into visual cues or vibration patterns, that must, in turn, be interpreted by the user -- a complicated skill acquisition process.

It might be borne in mind that computers in general, and microcomputers in particular because of their low cost and small size, are inherently valuable as "base technology" communication aids for the hearing impaired. Since most computer input and output devices (e.g., keyboard, CRT, printer) are in visual media, computer-assisted instruction is particularly relevant for deaf students. It is reported that more than 30 percent of the nation's hearing impaired students are using CAI.

Technology has also made attempts to address the speech disability of many hearing impaired persons. A number of microcomputer-based systems have been designed to help deaf individuals obtain skills in alternative personal communication modes, including a variety of procedures for the teaching of sign language and lip reading. Other technology-based devices, using voice recognition components, have been developed to serve as vocalization trainers for the hearing impaired, essentially serving as an adjunct to the speech therapist. These devices provide a graphic display of a student's vocalizations for ready comparison with standard sound.

C. NONVERBAL PHYSICALLY HANDICAPPED

The handicaps associated with loss of sight or hearing are relatively uniform across the range of individuals affected. Consequently, the technological means used to address these handicaps are similarly uniform. When we speak of the "physically handicapped", we are discussing a far broader range of types and degrees of disability.

The problems of the physically handicapped may be considered to fall into either of two categories: communication or mobility. It is our intent to discuss only aids which address the former. Since a substantial portion of the physically handicapped population are also nonverbal, many of the personal communication techniques available to hearing and speech impaired individuals (e.g., sign language, note writing) are not useful for some physically disabled persons who do not have use of their upper limbs. Moreover, such handicapped people are often more isolated than the hearing and speech impaired from modern information technology.

It is impossible, in a space as small as this, to describe even a fraction of devices and procedures which have been developed to allow physically handicapped persons to have access to technology. For the most part, these devices are designed to compensate for the lack of complete function of the arms or hands. Such simple devices as the mouth wand or head stick permit handicapped individuals with head movement to manipulate a computer keyboard. Blow tubes, switches, and joystick controls for the lips or chin provide binary mechanisms -- admittedly cumbersome -- by which a quadriplegic might control technological devices. Even ultrasonic head position controls and eye trackers have been shown to be potentially usable.

Indeed, the CRT screen of a microcomputer may, in itself, be a valuable communication tool, both to the computer and to the outside world for those with motor dysfunction. Many systems have been developed whereby special menus are displayed on the CRT -- they may be letters or words -- and, by any of a variety of mechanisms (such as those mentioned above), the cursor is moved to select entries of information.

For vocal severely physically handicapped individuals, the technology of voice recognition offers significant potential. While a universal voice recognition unit has not yet been developed, voice recognition/microcomputer systems have been created which can: (1) respond to the voice of a specific person for whose voice signature it is calibrated; (2) recognize a moderate number of words or phrases; and (3) perform tasks corresponding to those phrases. Such a system could, if designed for the purpose, allow a vocal

physically handicapped student to have full control over a microcomputer including the ability to program. The "Shadow/VET" voice entry terminal, manufactured by Scott Instruments and sold by Prentke Romich, is such a device.

Among the organizations which make available communication devices and services specifically designed for physically handicapped users are:

- Prentke Romich: produces a wide range of equipment for the physically disabled and is also compiling a catalog of microcomputer software for the disabled.
- Zygo Industries: specializes in hardware for the physically disabled, including the Tetra-Scan II which allows computer access through a single switch.
- Telesensory Systems: in addition to its other products (e.g., Optacon), produces the Autocom (marketed by Prentke Romich), an electronic lap tray for nonoral and motor-impaired individuals.
- Apple Computer: has prepared a document entitled "Personal Computers for the Physically Disabled".
- The TRACE Research and Development Center (University of Wisconsin): presents workshops and provides prescriptions for communication aids to help the physically disabled.
- The Applied Physics Laboratory of Johns Hopkins University: has conducted a "national search for applications of personal computing to aid the handicapped"; many applications have potential for physically disabled students.

Most of these various means of providing physically handicapped students with the capability to use instructional technology require special programming of the technology. Given the great variation in: (1) the type of physical handicap; (2) the degree or extent of handicap; (3) the type of communication mechanism used; and (4) the nature and type of the educational technology involved, it is generally accepted that such communication aid systems must be custom designed to the individual student and circumstance. Custom design is, of course, the ultimate in "thin" markets and highlights the continued expectations of high costs for such devices. These costs must be weighed against the enormous benefits which these aids can provide to handicapped individuals.

IV. FACTORS AFFECTING USE

The use of specialized communication aids in special education will be affected by a number of important factors. Included among these are information, training, funding, Federal involvement, and industry influence.

A. INFORMATION

Among the interested insights gained during the workshops for LEA special education officials was the realization that special administrators and teachers are often unfamiliar with the availability of these communication aids. In many parts of the country, children so disabled as to require the types of adaptive devices described above are not brought into public school systems, but rather taught in specialized education institutions. For this reason, local special educators do not often encounter in their programs students who are visually or hearing impaired or physically disabled.

During the next few years, educational "mainstreaming" may result in more handicapped children in the public schools. Information provided by the Federal Government, through projects such as this, will be helpful in making local special educators generally aware of the existence of communication aids. Because the number of such children in the schools will probably remain low, more specific information will have to be obtained on a case-by-case basis.

B. TRAINING

When communication aids are called for in an LEA's special education program, their use could require a substantial training effort for students, teachers, counselors, and administrators. Students, of course, must be trained in the use of special communication aids; in many cases, students may require a great deal of time to develop sufficient skills to make effective use of the devices. Similarly, teachers and other classroom personnel must be made aware of the special conditions under which such aids must operate and must be trained to integrate such devices into classroom operations. Counseling and

special education administrative staff must be trained to assess effectively the existing and future needs of the students. At the administrative level, the commonplace mobility of such aids (many will accompany the user beyond school boundariees) places a management burden on those LEA administrators who supervise facility/equipment inventories. Training in appropriate equipment management procedures and techniques may be necessary.

C. FUNDING

The generally high cost of these communication aids, and the expectation that they will remain so, makes the availability of funding a crucial factor in the ability of LEAs to provide such aids. The high cost of these specialized aids and the relatively small number of students who can benefit from them makes the per-pupil cost of such devices extremely high.

Because such devices can be used for the general (noneducational) benefit of handicapped persons, however, the cost of providing the communication aids can be ameliorated by contributions from other sources. The Veterans' Administration, vocational rehabilitation agencies, insurance providers, private foundations and organizations, and clients themselves (or their parents) can contribute to the costs of some aids. Mutually advantageous cost-sharing arrangements and (where possible) shared use of the devices can leverage LEA capital expenditures for communication aids to the point where they may be economically justified.

D. FEDERAL INVOLVEMENT

The Federal Government, usually through SEP, has provided important support for communication aids. Many of the devices described above have been developed with funding from SEP. In other cases, SEP has supported product development by providing a guaranteed market sufficient to provide incentive for developers and producers.

E. EXTERNAL INFLUENCE

More and more, industry today is providing specialized devices to its handicapped employees to enhance their potential job performance. As the incidence of these communication aids in industry (and, of course, in the home) increases, public schools may be under greater pressure from parents and employers to produce graduates who have the skills to work with these devices.

V. SUMMARY

A number of important factors differentiate the market for specialized communication aids for handicapped students from other new technology markets.

The high capital costs and small numbers of users of such devices make it difficult for LEAs in many cases to justify, on cost-effectiveness grounds, such purchases. Sharing of costs and use may help. However, the purchase of such aids may prove to be more cost-effective than alternative courses of action (e.g., private placement of students) and, in some cases, may be required by Federal or state regulations on mainstreaming.

The market is also extremely fragmented, consisting of individuals with a wide range of handicapping conditions and varying degrees of each. As a consequence, each component of the market is extremely thin. Indeed, frequently such communication aids must be "customized" to the individual needs of a particular person. This fragmentation makes marketing quite difficult.

These specialized aids are not generally distributed through the regular education dealers who are more geared to high volume items and are usually not equipped to handle the special technical aspects of such marketing. Most often these aids are distributed from the producer through a network of regional representatives who are more familiar with the technical intricacies of such devices. Their marketing is a very labor-intensive activity; it has been estimated that about 80 percent of the cost of these types of devices is devoted to such special marketing activities as up-front individual needs assessments and later technical assistance, training, and support.

Another key market factor is the mix of funding sources often used to purchase such devices. Distributors must, in many cases, deal with a wide range of decision makers in the purchasing process including:

- LEAs;
- vocational rehabilitation agencies;
- insurance providers;
- special organizations or foundations; and
- clients (or their parents).

Such a range of decision participants multiplies the marketing effort necessary.

Other factors which have had an effect on the market for communication aids for handicapped persons are the paucity of trained speech and language specialists (particularly in a time of budgetary tightness in the education system) and the political and legislative restrictions which often limit the home use of school-owned devices.

The combined effect of these factors has been to cause organizations providing communication aids to look to the "home market" rather than public schools as their most promising source of business. It may be expected that, as happens with microcomputers, communication aids may find their way into education through students, parents, and teachers who have such devices in their homes or on their jobs.

In general, we may expect a wider range of communication aids to be available during the next five years. However, it is highly unlikely that the costs of such aids will decrease in the manner of other electronic technologies.